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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/883,922	06/20/2001	Toshiaki Ono	010789	3735

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WASHINGTON, DC 20006

EXAMINER

ANDERSON, MATTHEW A

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 02/26/2003

5

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/883,922

Applicant(s)

ONO ET AL.

Examiner

Matthew A. Anderson

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 June 2001.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1- 16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 June 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All   b) ☐ Some \*   c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)                      4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)                      5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3,4 .                      6) ☐ Other:

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iida et al (EP0962557) in view of Wolf et al. (Silicon Processing for the VLSI Era, Volume 1: Process Technology, Lattice Press, Sunset Beach, CA, USA, pp. 8-11, 27-33, 36-72, 124, 139-142, 1986.).

Iida et al. discloses a method of pulling a silicon single crystal ingot according to the Cz (Czochralski) method. The cooling rate of the ingot from 1150-1080°C was disclosed as 2.30°C/min or more. The rapid cooling was said to decrease the density and size of the grown in defects. Nitrogen doping was also suggested in the range from  $1.0 \times 10^{10}$  to  $5 \times 10^{15}$  atoms/cm<sup>3</sup> (page 2 item 12. Paragraph 10 page 2 indicates that a faster crystal growth speed (i.e. a faster cooling rate) improves productivity.

Iida et al. does not specify the range 7.3°C/min or more cooling rate.

Wolf et al. on page 11 discloses that interstitial agglomeration defects are prevented by quenching during the temperature range interstitial point defects

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are mobile within the crystal lattice (i.e. from 1421°C to about 950°C). The agglomerated interstitial point intrinsic defects are dislocation loops. On page 49, it is further intimated that the temperature range of the diffusion (i.e. mobility) of supersaturated Si self-interstitial point defects is between about 400 to 1200 degrees Celsius. On pages 59-61 oxygen in Si is detailed as forming precipitates at approximately 550-800°C. On page 66, oxygen precipitates are disclosed as good for intrinsic gettering sites. Fig. 16 discloses the relationship of oxide in Si to wafer warpage resistance. Nitrogen doping for the same purpose is suggested on page 32. Page 140 discloses the warpage resistance as critical for epitaxial Si wafers. On page 141 the use of IG (intrinsic gettering) of the substrates prior to deposition is described. The examiner notes that the processing parameters are result effective as disclosed on page 61

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine Iida et al. with Wolf et al. because Iida et al. discloses the quenching of Si ingots pulled with the Cz method to prevent the agglomeration of vacancy point defects in a certain temperature range and Wolf et al. discloses that the quenching in the temperature range of 1421 to 400 °C prevents agglomeration of interstitial and vacancy point defects in Cz Si. The use of quench cooling in Cz Si pulling is thus well established.

It would have been to one of ordinary skill in the art at the time of the present invention to optimize the cooling rate because Iida et al. suggests faster rates increase the productivity of the process and such optimization would have been achieved with only routine experimentation.

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It would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the temperature range of fast cooling because Iida et al. discloses such ranges as useful for Si defect control and Wolf et al. suggests defect agglomeration as reduced with quenching (i.e. high cooling rates).

In respect to claims 3, 6, 7, 8, 9, 11, 16, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the oxygen and nitrogen concentration of the Si single crystal because and Wolf et al suggests an oxygen concentration of 25 ppma (page 27; this is  $1.25 \times 10^{18}$  atoms/cm<sup>3</sup> by extrapolation of the typical concentrations given on page 59) and suggest nitrogen doping for warpage resistance.

In respect to claim 4, 5, 12, 13, 14, 15, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow an epitaxial layer on a silicon wafer produced from an Si ingot because such epitaxial layers (including those formed on IG substrate wafers) were known in the art. (see Wolf page 124).

In respect to claims claim 2, 8, 9, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the fast cooling and slow cooling of a silicon crystal through the specified temperature ranges because this was disclosed as useful for forming oxygen precipitates and thus IG substrates for further production of Silicon epitaxial wafers and because such optimization of result effective process parameters would have been achieved with only routine experimentation.

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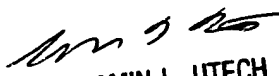
**Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA  
February 22, 2003

  
BENJAMIN L. UTECH  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700